

## PATENT SPECIFICATION

(11)

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## DRAWINGS ATTACHED

785

- (21) Application No. 23811/70 (22) Filed 16 May 1970  
 (23) Complete Specification filed 18 May 1971  
 (44) Complete Specification published 31 May 1973  
 (51) International Classification F16D 3/62  
 (52) Index at acceptance  
 F2U 554 566 568 572  
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(19)



## (54) IMPROVEMENTS IN COUPLINGS

- (71) We, DUNLOP HOLDINGS LIMITED (formerly The Dunlop Company Limited), a British Company of Dunlop House, Ryder Street, St. James's, London, S.W.1, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—
- 5 This invention relates to flexible couplings. One object of the present invention is to provide an improved flexible coupling.
- 10 According to one aspect of the invention a flexible coupling comprises a pair of rigid members, each rigid member having a base portion from each extend a plurality of limbs, the pair of rigid members being arranged relative to one another in the form of a loosely fitting assembly, and a cushioning element of elastomeric material being arranged centrally in the assembly to extend into spaces between adjacent limbs of the respective members and being shaped to permit a predetermined angle of substantially free play between the rigid members.
- 15 Preferably each rigid member is arranged within the length of the other rigid member so as to minimise the length of the coupling, and each rigid member may conveniently be U-shaped.
- 20 One embodiment of the invention will now be described, by way of example, with reference to the accompanying drawings in which:—
- 25 Figure 1 is a perspective view of a steering column coupling;
- 30 Figure 2 is a perspective view of one of the rigid members shown in Figure 1;
- 35 Figure 3 is an end view of the coupling shown in Figure 1.
- 40 A coupling 10 for use in a motor vehicle steering column comprises a pair of similar generally U-shaped rigid members 11, 12 arranged in an assembly so that the limbs 13, 14 of each U-shaped member extend from their respective bases 15, 16, longitudinally with respect to the axis of the coupling, towards the base of the opposite member.
- 45
- The limbs 13, 14 of each of the two members being axially coextensive with the limbs of the opposite member. 50
- Each rigid member 11, 12 (Figure 2) may be formed from steel plate, the base 16 being substantially rectangular and the limbs 14, extending at right angles to the base, each having a generally rectangular body portion 17 which is bent adjacent its longitudinally extending sides to form a pair of flanges 18 extending radially outwardly, relative to the axis of the coupling. 55
- Each U-shaped rigid member 11, 12 is also provided with a pair of mounting lugs 19, 20 lying in a plane perpendicular to the axis of the coupling. Each mounting lug is formed from a bent-over portion of the outer end of its respective limb and has a location hole 21, 22 formed therein. 60
- The rigid members 11, 12 may alternatively be made as castings, sintered metal components, or may be produced by any other suitable method such as a deep drawing process. 65
- To mould a cushioning element 23 the two rigid members 11, 12 may be assembled in a mould with a block of uncured rubber positioned in the space bounded by the four limbs of the members, or a transfer moulding process may be employed. The mould is provided with thin wedge-shaped inserts which enter radially into the generally diagonally extending spaces formed between the flanges of adjacent limbs. The assembly is moulded and cured in a conventional manner, and during the moulding process the inserts produce deep and relatively narrow grooves 24 of V-shaped cross-section in the portions of the moulded rubber block 23 which lie between the diagonal flanges of adjacent limbs. 70
- The dimensions of the mould inserts are chosen so that in the finished moulded coupling the grooves 24 provide sufficient space between the flanges of the pairs of adjacent flanges to permit 3° angular rotation of one rigid member relative to the other. 75
- When installed in a steering column the 80
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- 90
- 95

[Price 25p]

- arrangement described above enables the steering wheel to be rotated through  $3^\circ$  with relatively little resistance in the coupling, the resistance being provided solely by shear in the central portion of the rubber block 5 in the central portion of the rubber block 23. After the clearance of  $3^\circ$  has been taken up, the rubber between the flanges of the adjacent limbs if put into compression as the side faces of the respective grooves 10 24 engage one another, and the torsional stiffness of the coupling rises rapidly. Alternatively the cushioning element may be formed from a number of segments of polymeric material each bonded to the rigid 15 members.
- The coupling described above thus has a low torsional stiffness under normal straight-line running conditions of a vehicle, serving to insulate the steering wheel from vibrations 20 in the steering mechanism, and also has the property of stiffening up rapidly to maintain accurate control when cornering.
- Whilst the coupling described provides  $3^\circ$  of relatively free play, the grooves may be shaped to provide other angles of free play, typically in the range  $0^\circ$  to  $10^\circ$ .
- A coupling comprising a pair of U-shaped interengaging rigid members may also be formed substantially in the manner described 30 above except that the cushioning element is bonded to the flange of only one of each pair of adjacent limbs, no grooves being formed in the element. In such an arrangement the cushioning element will be spaced from the flange of the other limb of the associated pair of adjacent limbs to form a gap which effectively constitutes a relieved portion so as to permit a limited angle of 35 relatively free play between the rigid members.
- It will be noted that the coupling described above has "fail-safe" properties both in respect of torsional and axial displacement of the rigid members should the bonding of the rubber to the metal members fail or break-up occur in the rubber.
- A flexible coupling according to the invention is also suited to other applications such as, for example, coupling together a 50 pair of components of a drive transmission for a motor vehicle. The general flexibility of the coupling renders it particularly suitable for transmitting motion between a pair of components having non-aligned axes of rotation and the two-rate characteristic of the coupling serves to protect associated transmission components from harmful shock loadings.
- WHAT WE CLAIM IS:—**
- 60 1. A flexible coupling comprising a pair of rigid members, each rigid member having a base portion from which extend a plurality of limbs, the pair of rigid members being arranged relative to one another in the form of a loosely fitting assembly, and a cushioning element of elastomeric material being arranged centrally in the assembly to extend into spaces between adjacent limbs of the respective members and being shaped to permit a predetermined angle of substantially free play between the rigid members. 65
2. A coupling according to claim 1, wherein the limbs of each of the respective members are axially co-extensive with the corresponding limbs of the other member. 70
3. A coupling according to any of the preceding claims wherein each limb extends in a direction substantially parallel to the axis of the coupling. 75
4. A coupling according to any of the preceding claims wherein the limbs of each member extend towards the base portion of the opposite member. 80
5. A coupling according to any of the preceding claims wherein each rigid member is substantially U-shaped. 85
6. A coupling according to claim 5 wherein the outer end of each limb is formed with a mounting lug extending in a direction substantially perpendicular to the axis of the coupling. 90
7. A coupling according to any of the preceding claims wherein each limb is formed with a pair of flange portions extending radially with respect to the axis of the coupling. 95
8. A coupling according to claim 7 wherein a groove is formed in the material of the cushioning element between the flange portions of each pair of adjacent limbs, the grooves extending substantially parallel to the axis of the coupling. 100
9. A coupling according to any of the preceding claims wherein the grooves are of substantially V-shaped cross-section. 105
10. A coupling according to any of claims 1 to 7 wherein the cushioning element is bonded to only one limb of each adjacent pair of limbs of the assembly. 110
11. A coupling constructed and arranged substantially as hereinbefore described and illustrated in the accompanying drawings. 115
12. A rotatable assembly comprising a pair of rotatable members and a coupling according to any of the preceding claims arranged to transmit rotary movement between the rotatable members. 120
13. A vehicle transmission comprising an assembly according to claim 12. 125
14. A steering column comprising a coupling according to any of claims 1 to 11. 130
15. A method of manufacture of a flexible coupling according to any of claims 1 to 11 comprising assembling the two rigid members in a mould with a block of uncured elastomeric material positioned in the space bounded by the radially outer extremities of the limbs of the rigid members, the mould being provided with inserts which extend be-

tween adjacent limbs of the pair of rigid members in a direction substantially parallel to the axis of the coupling so as to form grooves or relieved portions in the elastomeric material, and moulding and curing the assembly of rigid members and elastomeric material.

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Printed for Her Majesty's Stationery Office by Burgess & Son (Abingdon), Ltd.—1973.  
Published at The Patent Office, 25 Southampton Buildings, London, WC2A 1AY,  
from which copies may be obtained.

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COMPLETE SPECIFICATION

2 SHEETS

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the Original on a reduced scale*

Sheet 1

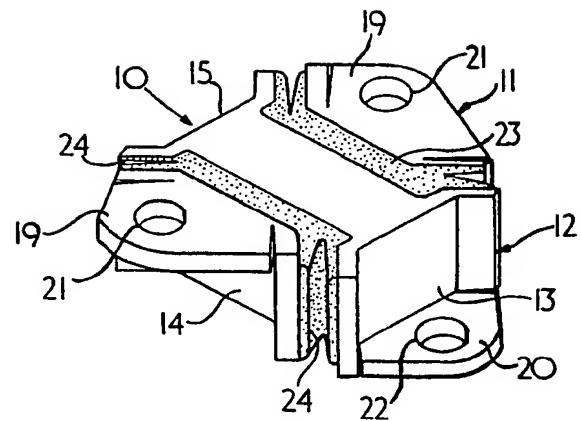


FIG.1.

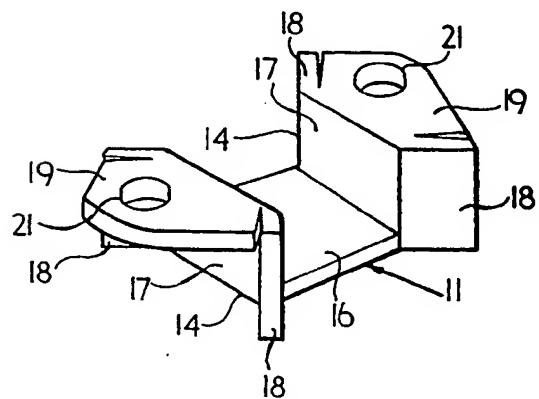


FIG.2.

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COMPLETE SPECIFICATION

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Sheet 2*

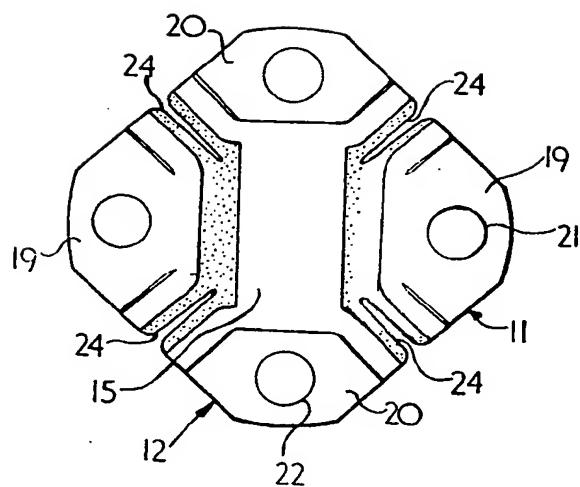


FIG.3.

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